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BERMAN H S.		
BRANCH, D. B.		
CARNIVAL, G. J.		
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FERRERA, D W		
HANNI, B. J		
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HILBIG, J G.		
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KELL R E.		
KIRBY W A.		
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MORGAN R. V		
POTTER, G. L.		
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SANO' IN ' N B.		
SETLOCK, G. H		
STEWART D L.		
STIGER S. G.	✓	
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SWANSON, E. R.		
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WILSON J. M		
WYANT R. B.		
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TR APPROVALS:

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EG&G ROCKY FLATS

EG&G ROCKY FLATS INC
ROCKY FLATS PLANT P O BOX 464 GOLDEN COLORADO 80402 0464 (303) 966 7000

000030047

May 25 1994

94 RF 05927

Scott R Grace
Environmental Restoration Division
DOE RFFO

LETTER OF TRANSMITTAL MINUTES FROM THE MAY 19 1994 TEST PLAN FOR OPERABLE UNIT NO 2 SITE PJL 028 94

EG&G Rocky Flats Inc is transmitting copies of minutes from an Environmental Protection Agency/Colorado Department of Health/Department of Energy/EG&G Rocky Flats Inc /Pacific Northwest Laboratories Battelle(EPA/CDH/DOE/EG&G/PNL) meeting held on May 19 1994 The meeting was held to discuss the Test Plan for Test Site 2 under the current Operable Unit No 2 Subsurface Interim Measure/Interim Remedial Action Soil Vapor Extraction program

If you have any questions regarding the minutes please contact R E Madel of Environmental Engineering & Technology extension 6972

P J Laurin
Operable Unit No 2 Manager
Remediation Program Management

REM cb

Orig and 1 cc S R Grace

Attachments
As Stated (3)

c
R J Schassburger DOE/RFFO
A Dille Aguire
C Greengard SAIC

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ADMIN RECORD

MEETING NOTES
OU2 IM/IRA
SVE PILOT TEST PROGRAM
TEST SITE NO 2
5/19/94

MEETING ATTENDEES

NAME	ORGANIZATION	PHONE/PAGER
Eric Dille	Aguirre Eng	966 4651
Dick Fox	CDH	692 3251/6184
Bill Fraser	EPA	294 1081
Scott Grace	DOE/RF	966 7199
Tom Greengard	SAIC	966 3677
Michael Klein	EG&G/EE&T	966 6950/7458
Robin Madel	EG&G/EE&T	966 6972/7476
Jim McLaughlin	EG&G/EE&T	966 6995
Janet Roberts	PNL	(509) 373 6578
Carl Spreng	CDH	692 3358
Jeff Swanson	CDH	692 3416
Marcia Walter	PNL	(509) 372 3348

Agenda Attached (Attachment A)

SIX PHASE SOIL HEATING (SPSH)/ SAVANNAH RIVER SITE OVERVIEW
- clay layer
- PCE/TCE
- heating in clay layer (6 electrodes)
- achieved up to 99 9 / removal of PCE and TCE

TEST PLAN PRESENTATION (Attachment B)
- conceptual model of geology and contamination presented
- objectives of SPSH presented
- SPSH at RFP conceptual model
  - trench would be covered with a plenum
  - horizontal wells along trench boundary
- test design approach
  - still need some design parameters (details will be in test plan
    determined through engineering calculations and modeling of the power/heat dissipation in soil)
- will use the observational approach to design well set up
- determine test performance
- comparison of SPSH to SVE large peak of contamination is seen quickly
- data to be collected was discussed

Q Conceptual models presented in the past do not seem to match the models presented here

A Models are similar but now are based on actual operation of SVE (changing equilibrium conditions) Now we have NAPL being pulled into ground water sand stone unit Now we know most of the contamination is in the alluvium We will be targeting the same portion of NAPL that site 1 is reaching now The depth of the heated region will be determined when drilling begins Role of micro organisms in the overall process not discussed as part of test summary

Test Plan Preliminary Outline presented (Attachment C)
Outline for Test Plan presented briefly

Schedule presented still being refined final will be included in the Test Plan

Off gas treatment technology
not meant as a demonstration want a proven technology
3 choices
1 conventional incineration
2 flameless incineration
3 UV ozone/GAC
Technologies were screened on a variety of criteria
Thermal oxidation met all criteria
Exceeds RACT performance criteria (99 99 ′ for incineration vs 90 95 / for RACT)
Implementation of the off gas will be affected by EPA/CDH approval
need to move through the process smoothly CDH regulator for incineration can t comment until TM 2 is presented EPA permit waiver under CERCLA applies CDH substantive requirements are greater than administrative requirements the system may or may not require permitting as an incinerator
Copies to CDH 4 or 5 copies CDH retreat on Friday 5/20/94
The critical reviewer will need to set the schedule
Dave Waltz is doing incineration regulations for CDH
We will proceed along assuming there will not be problems

SVS Report No comments from EPA or CDH
Report was considered informational only

SW 59 No options for treatment were presented but EPA/CDH was informed that we will be presenting options to them soon

MEETING AGENDA
OPERABLE UNIT NO 2 IM/IRA
SOIL VAPOR EXTRACTION PILOT TEST PROGRAM
TEST SITE NO 2
MAY 19 1994

Introduction

- Savannah River/Six phase Soil Heating Technology Overview

Rocky Flats Plant/OU 2 Test Site 2 Test Plan

Outline for Test Site 2 Test Plan

- Off gas Treatment Technology Selection

Milestone Schedule

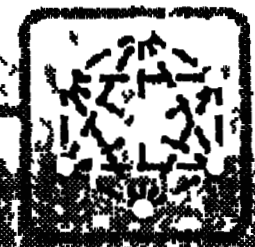
Other Topics
Soil Vapor Survey Report Agency Comments
Treatment of surface water seep SW 59

3/32

Schedule for the OU 2 Subsurface IM/IRA SVE Test Site 2 Program

Activity	Preliminary Schedule
TM 2 (Off gas treatment)	5/94 6/94
Off gas treatment design	6/94 9/94
Off gas treatment procurement fabrication and delivery	9/94 6/95
TM 3 (Program changes)	6/94 9/94
TM 4 (Additional Site Characterization)	6/94 10/94
Test Site 2 Test Plan	7/94
Planning and Documentation	8/94 6/95
Site Design	8/94 6/95
Site Operations	12/94 7/95
Site 2 Testing	7/95 11/95
Test Site 2 Demobilization	11/95 12/95
Test Site 2 Report	12/95 2/96

SIX-PHASE SOIL HEATING



Soil Vapor Extraction Pilot Test Plan Test Site Number 2

Enhanced Vapor Extraction of Organic Compounds with Six-Phase Soil Heating

Preliminary Conceptual Review

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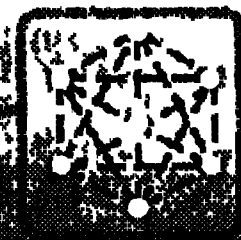
SIX-PHASE SOIL HEATING



Outline

- Problem: Contamination of Rocky Flats Site
- Proposed Solution: SPSH & Test Objectives
- Measuring Success: Data Collection and Analysis

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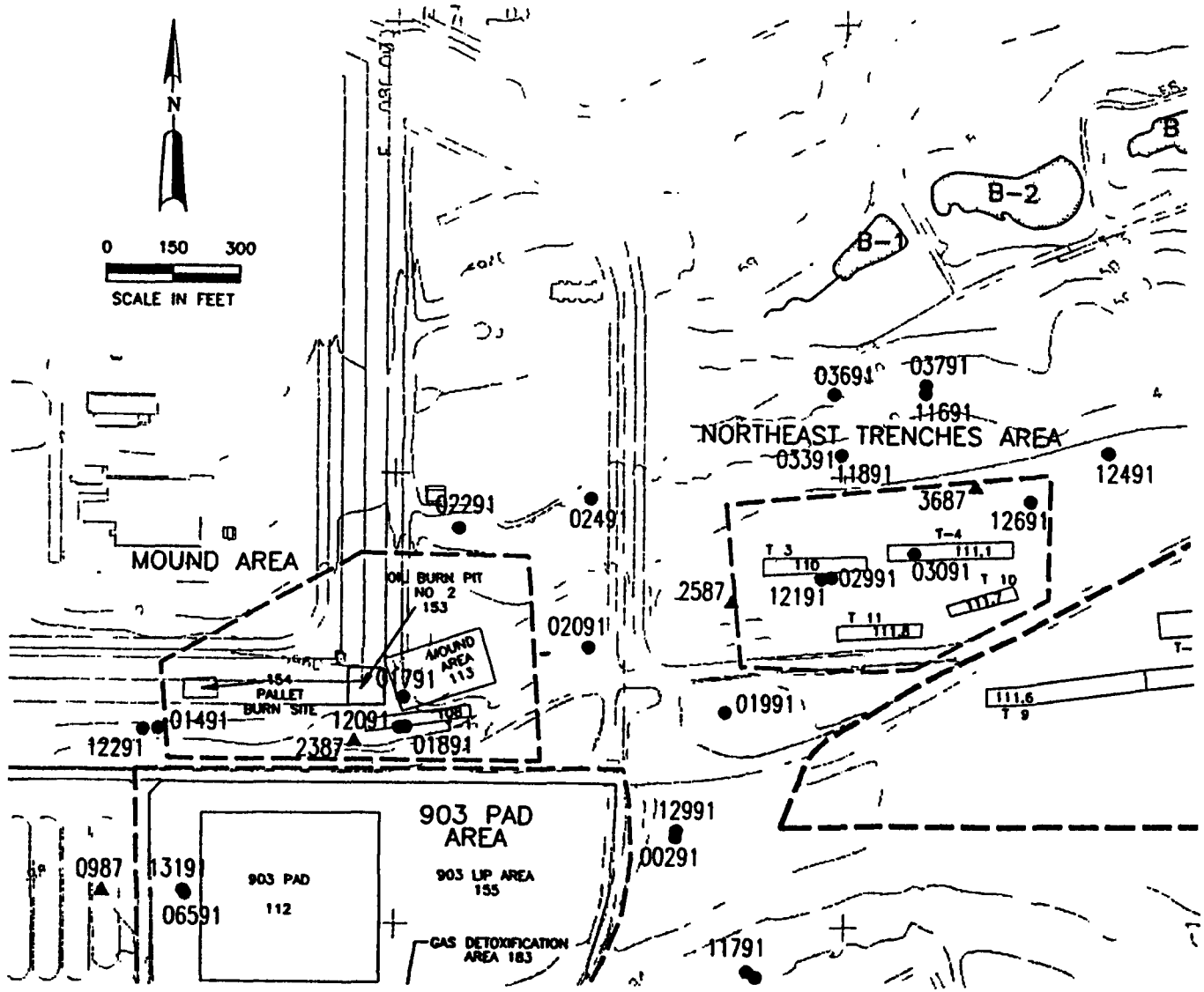
Rocky Flats Contamination History

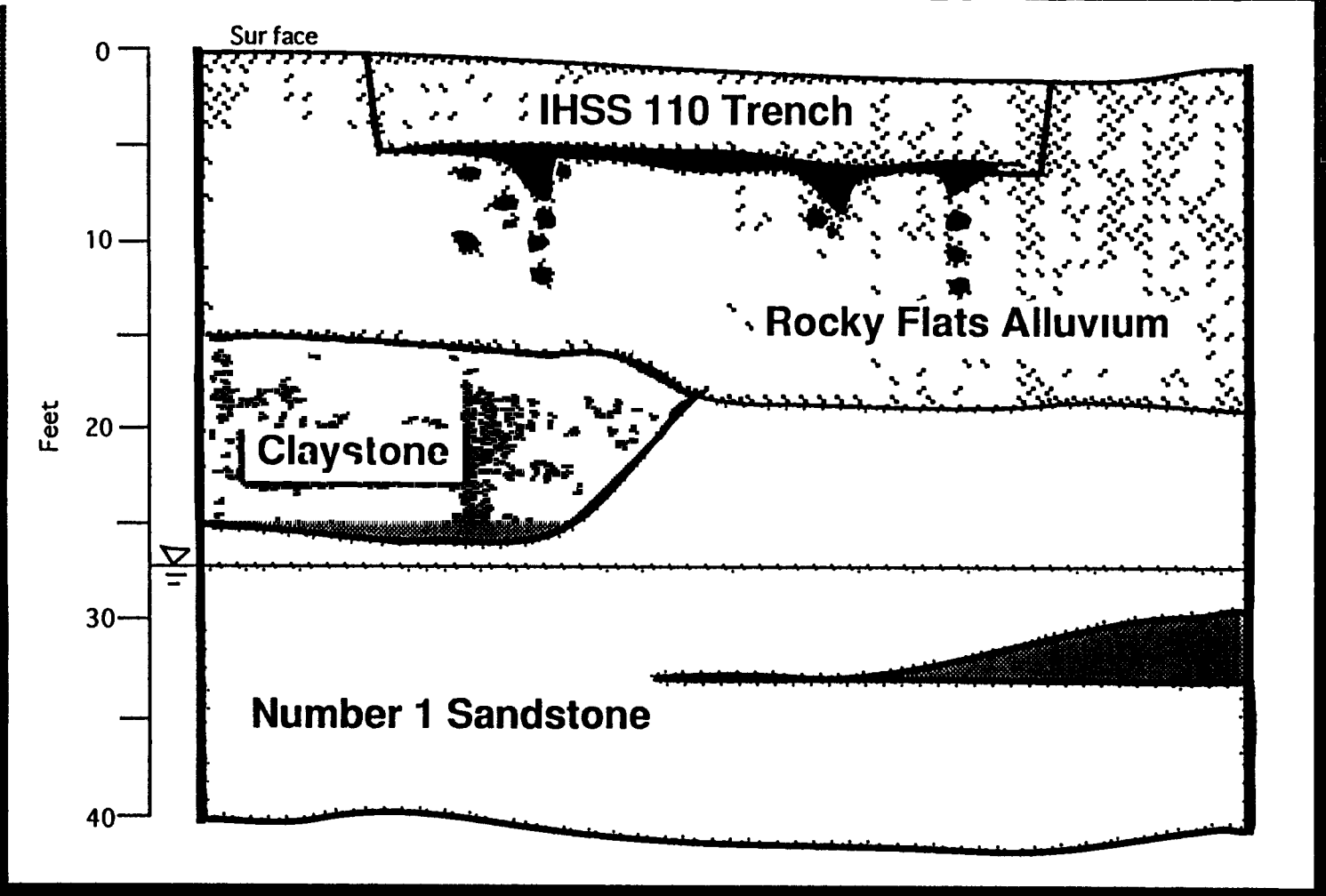
- Rocky Flats site was responsible for machining nuclear weapon components, a process requiring solvents and machine oil / lathe coolant.
- Primary waste stream:
  - Volatile Organic Compounds (PCE, CCl4, TCE) potentially dissolved in machine oil
- Contaminants disposed of in mounds and trenches at the site.
- Waste was generated and disposed of in the IHSS 110 trench between 1954 and 1963.

IHSS 110 Trench



SIX-PHASE SOIL HEATING

Site Conceptual Model



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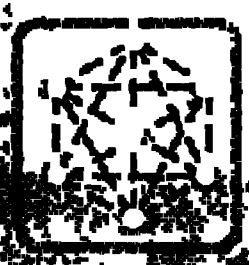
SIX-PHASE SOIL HEATING



- [illegible]
- Subsurface stratigraphy
  - Rocky Flats Alluvium: Surface to ~15', 10^{-4} cm/sec
  - Claystone: ~10' thick layer underlying the RFA and in lenses within the sandstone, 10^{-5} cm/sec
  - Number 1 Sandstone: Bedrock underlying region, 10^{-3} cm/sec
- Water table typically at ~25-30' but can be temporarily perched on claystone layer at <15' from the surface.
- IHSS 110 Trench

  Bulldozed 5-10' deep, backfilled with RFA.
- Contamination

  VOCs in machine oil, perched in trench area, possibly on claystone. Held in vadose zone by capillary forces.

  Groundwater contamination likely due to contact with vapor phase VOCs and surface water transport through contaminated region.

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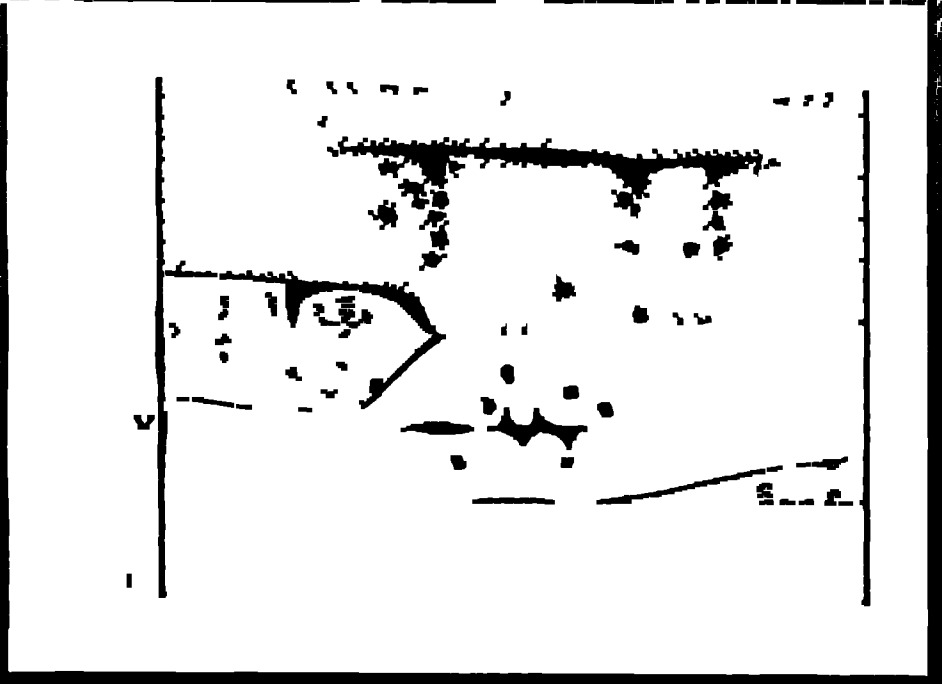
SIX-PHASE SOIL HEATING

Limitations of SVE

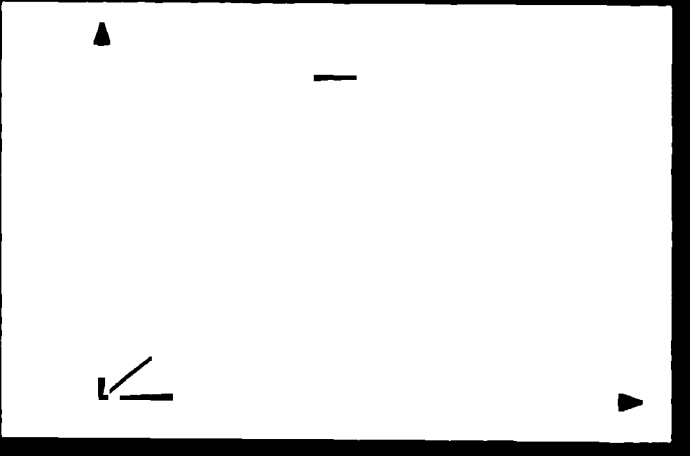


- Tight soil leads to small radius of influence
- Low permeability layers are bypassed

Complications of NAPL:

- Small contact area for mass transfer.
- Reduces pore space for flow.

Complications of Co-Contaminant:



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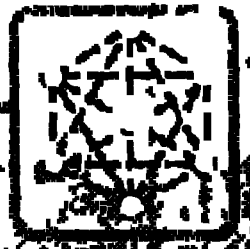
SIX-PHASE SOIL HEATING



S.M. Stocker Number 1 Data

- Gas extraction rate: 5 - 10 scfm at 0.6 psia
- VOC removal rate: 2.4 - 3.6 lb/day
- Radius of influence: 10 - 20 ft
- Offgas makeup: 50% PCE, 40% CCl_4, 10% others
- Time to remediate:
  - 4.6 - 18.25 years
  - (assumes 16,000 lbs VOC present and no decay in offgas concentrations)

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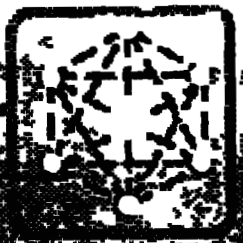
SIX-PHASE SOIL HEATING



Thermal Enhanced SVE

Why Heat?

- Increase contaminant concentration in gas phase (increase partial pressure and boil contaminant).
- Creates steam in situ to increase flow through contaminated regions.
- Reaches low-permeability zones not treated by conventional venting or steam injection.

Why use Six-Phase Soil Heating?

- Creates more uniform heating.
- Relatively low capital costs by using standard utility transformers.

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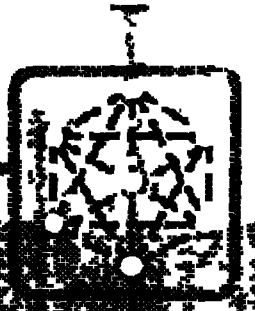
SIX-PHASE SOIL HEATING

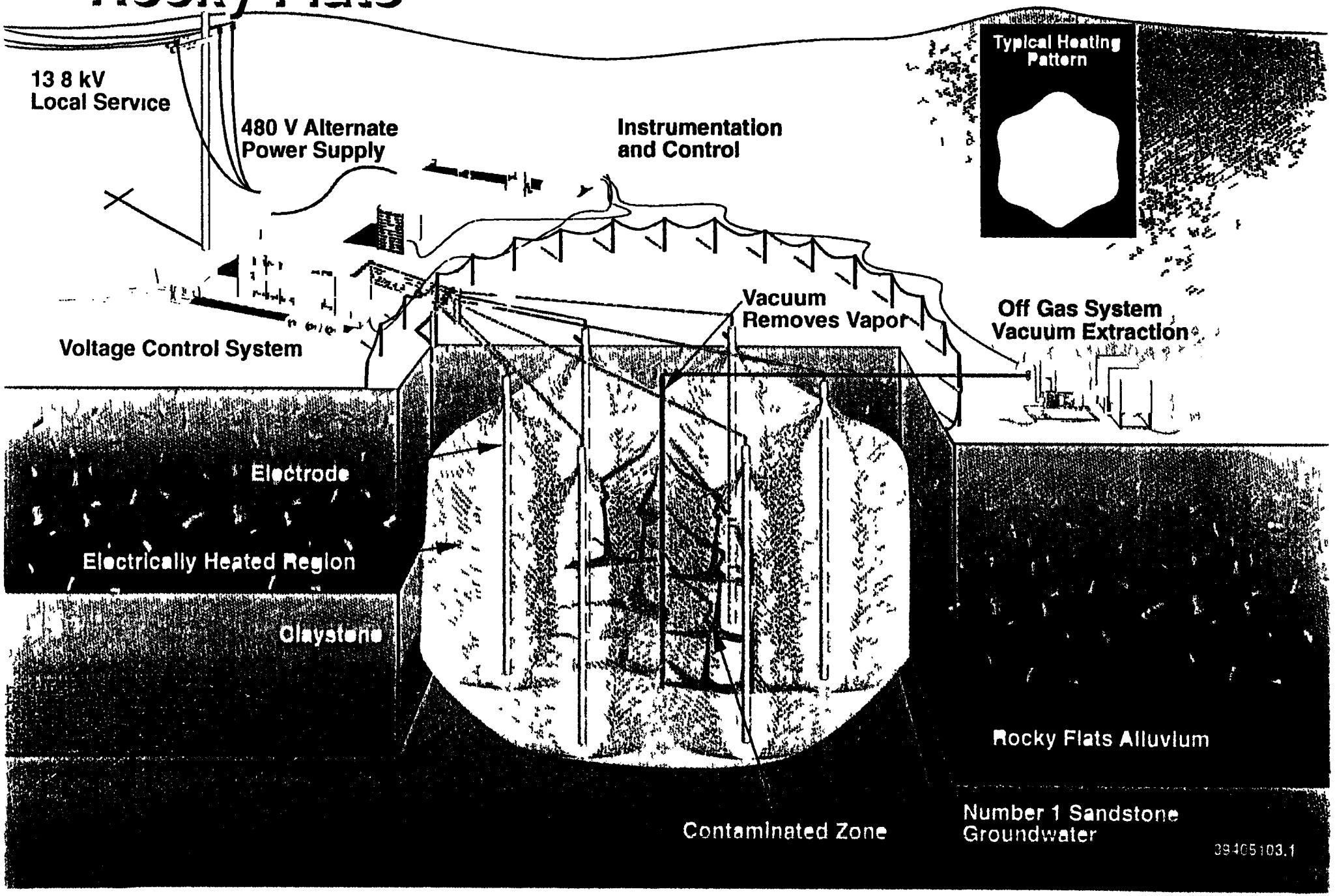


Objectives

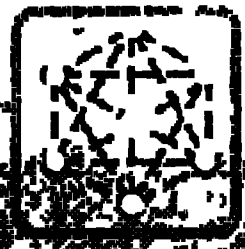
The purpose of Pilot Test Number 2 is to evaluate if SPSH is an effective technique for remediating contaminated soils at OU2.

- effectiveness
- implementability
- cost

Six Phase Soil Heating
Rocky Flats



SIX-PHASE SOIL HEATING



SFSH Core Model

- Six modified pipe electrodes are installed in a circular array.
- Line power transformed to appropriate voltage and supplied in six phases to electrodes.
- Soil is heated resistively as electrical current passes through it.
- Contaminants volatilize and are extracted through traditional SVE vents and a surface plenum.
- Offgas stream is run through a condenser and destruction technology, liquid condensate will be stored onsite (described in detail in Tech. Memo. 2).
- Observational approach used for electrode installation.
- Expected power consumption is 500kW, and wetting rate is 1-2 gph per electrode.
- Expect to leave behind all NAPL with VOCs removed.

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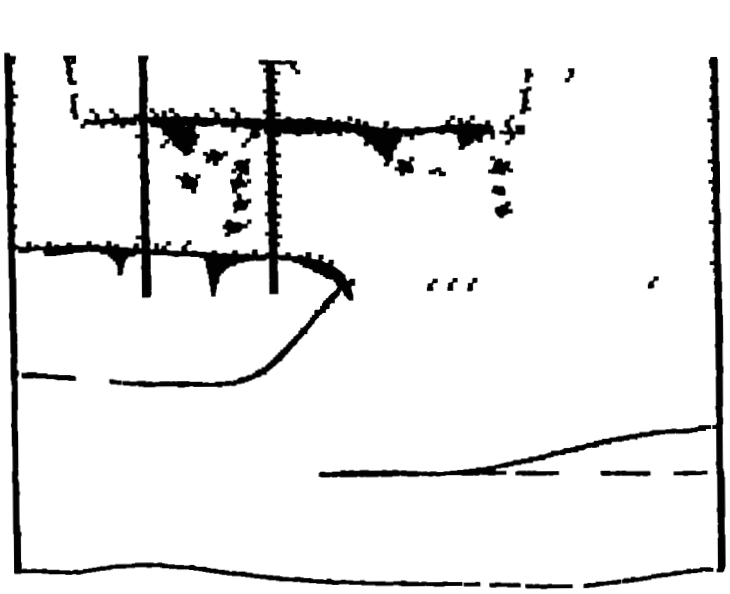
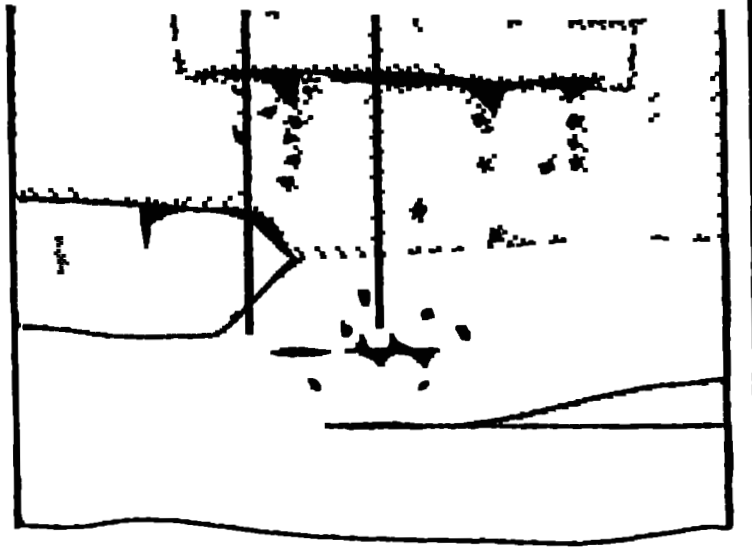
SIX-PHASE SOIL HEATING



Heating Vadose Zone



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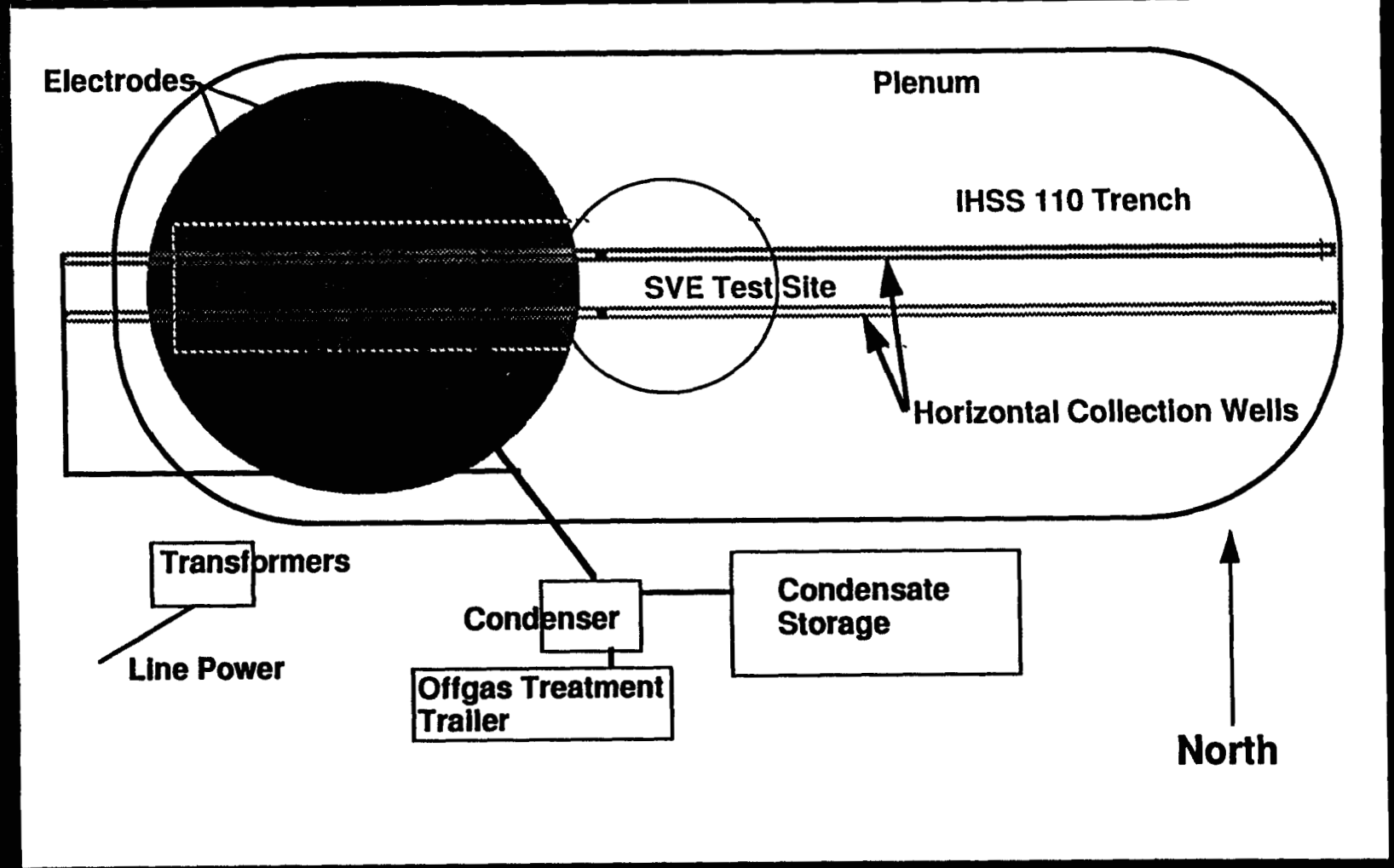
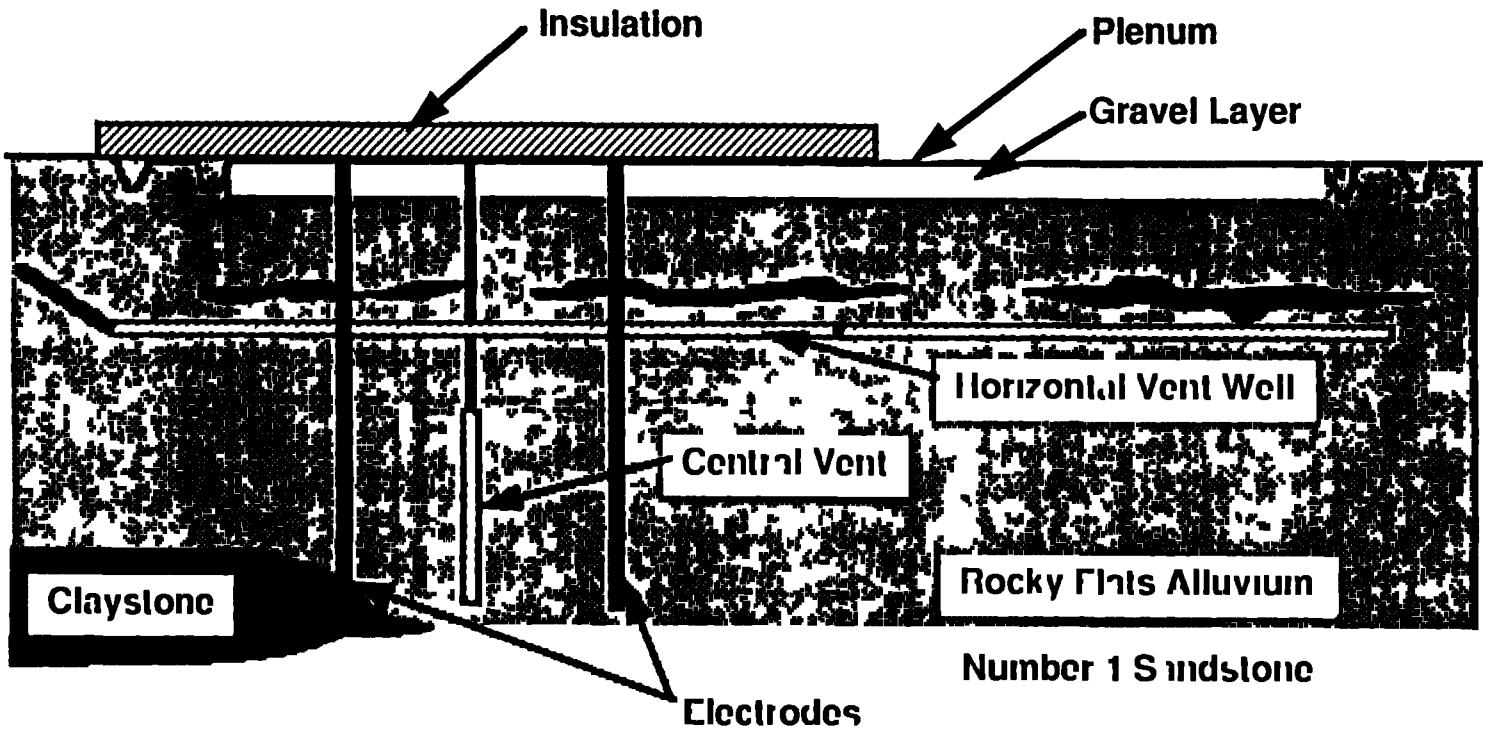
SIX-PHASE SOIL HEATING

SPSH Layout



SIX-PHASE SOIL HEATING

SPSH Layout



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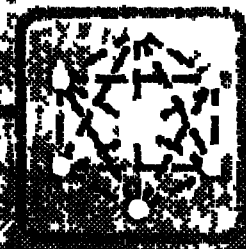
SIX-PHASE SOIL HEATING



Test Design Approach

Required Test Parameters:

- SPSH geometric design.
- Vent placement and wetting rates.
- Heating rate to maximize heating uniformity.

Parameters specified through engineering calculations and computer simulations.

Observational design approach to insure success.

Multiple measures of performance.

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SIX-PHASE SOIL HEATING

Determining SPSH Performance

- Pre-test characterization (soil sample analysis for VOCs)
- Baseline to project SVE alternative (offgas and soil conditions)
- Heating phase (offgas and soil conditions)
- Post-test characterization (soil sample analysis for VOCs)

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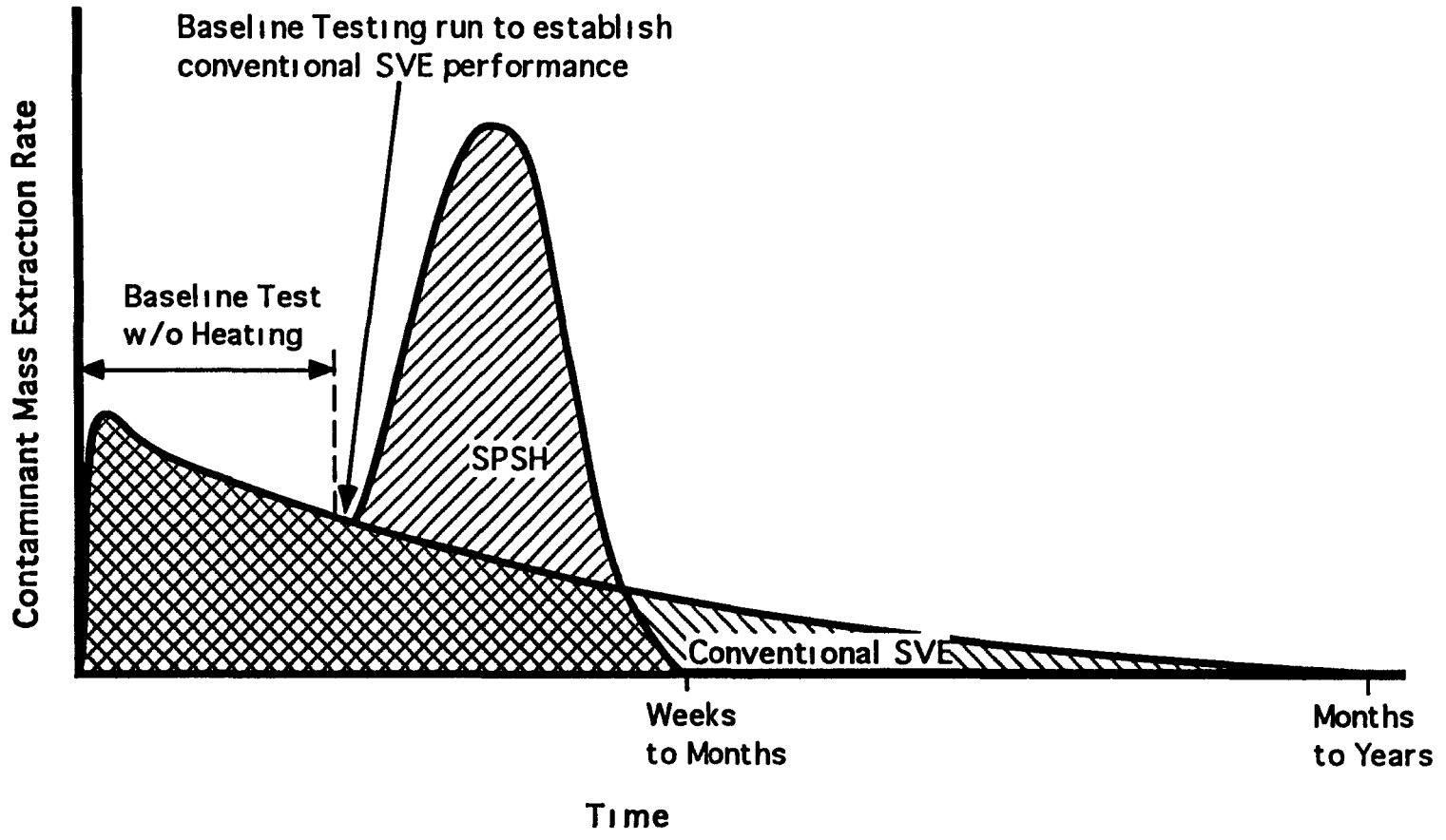
SPSH vs SVE



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SIX-PHASE SOIL HEATING

Existing Data

- Reasonable permeability, porosity, & water content estimates
- Some contamination data (groundwater, soil vapor, & 10151 soil sample analysis)
- Rough stratigraphy of subsurface
- SVE Test Site 1 data

Required Data

- Site specific soil properties (trench, alluvium, claystone, & sandstone)
- Pre- and post-test NAPL characterization (amount, location, & constitution)
- More detailed stratigraphy of subsurface

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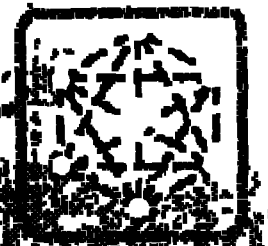
SIX-PHASE SOIL HEATING



On-Line Sampling

Data to be collected:

- Offgas flowrate, VOC concentration, pressure, & temperature
- Subsurface VOC concentration, pressure, & temperature

Data used to:

- calculate contaminant and water mass balance
- evaluate increase in removal rate over conventional SVE
- subsurface thermocouples to define heating performance
- subsurface pressure sensors to evaluate flow direction

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SIX-PHASE SOIL HEATING

Summary

- Site conceptual design
  - NAPL in trench area, probably VOCs in all
  - Low permeability, layered soil formations
- SPSH conceptual design objectives
  - compare SPSH to SVE
  - evaluate how co-contaminants / NAPL effect speed of remediation
  - evaluate O&M reliability and cost effectiveness of SPSH for applications at Rocky Flats.
- Test performance evaluation
  - Pre- and post-test soil VOC concentration measurements
  - Offgas concentration measurements
  - Remediation will leave behind oil, cleaned of VOCs.
- Data needs (Technical Memorandum 4)

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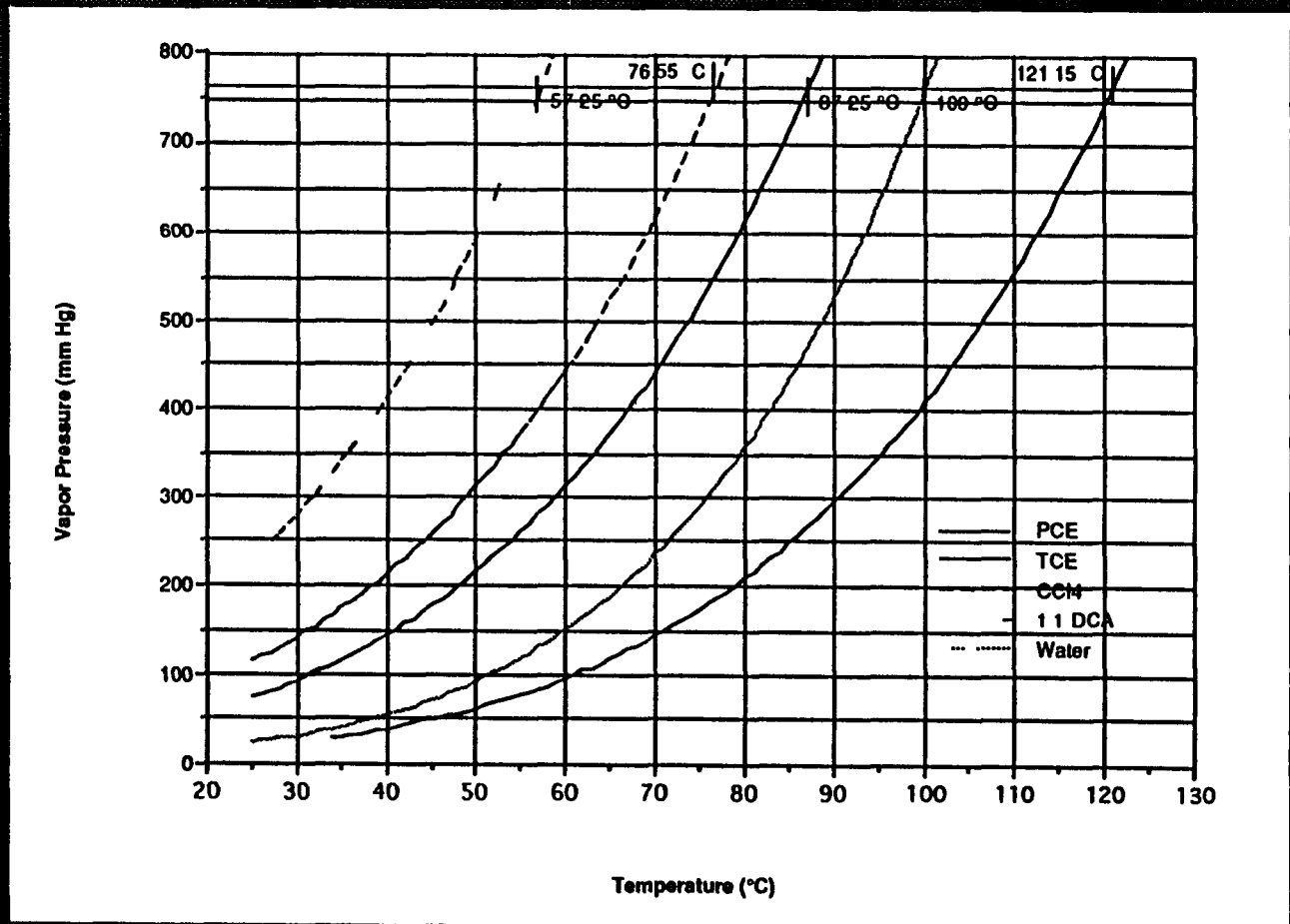
Partial Pressure vs. Temperature



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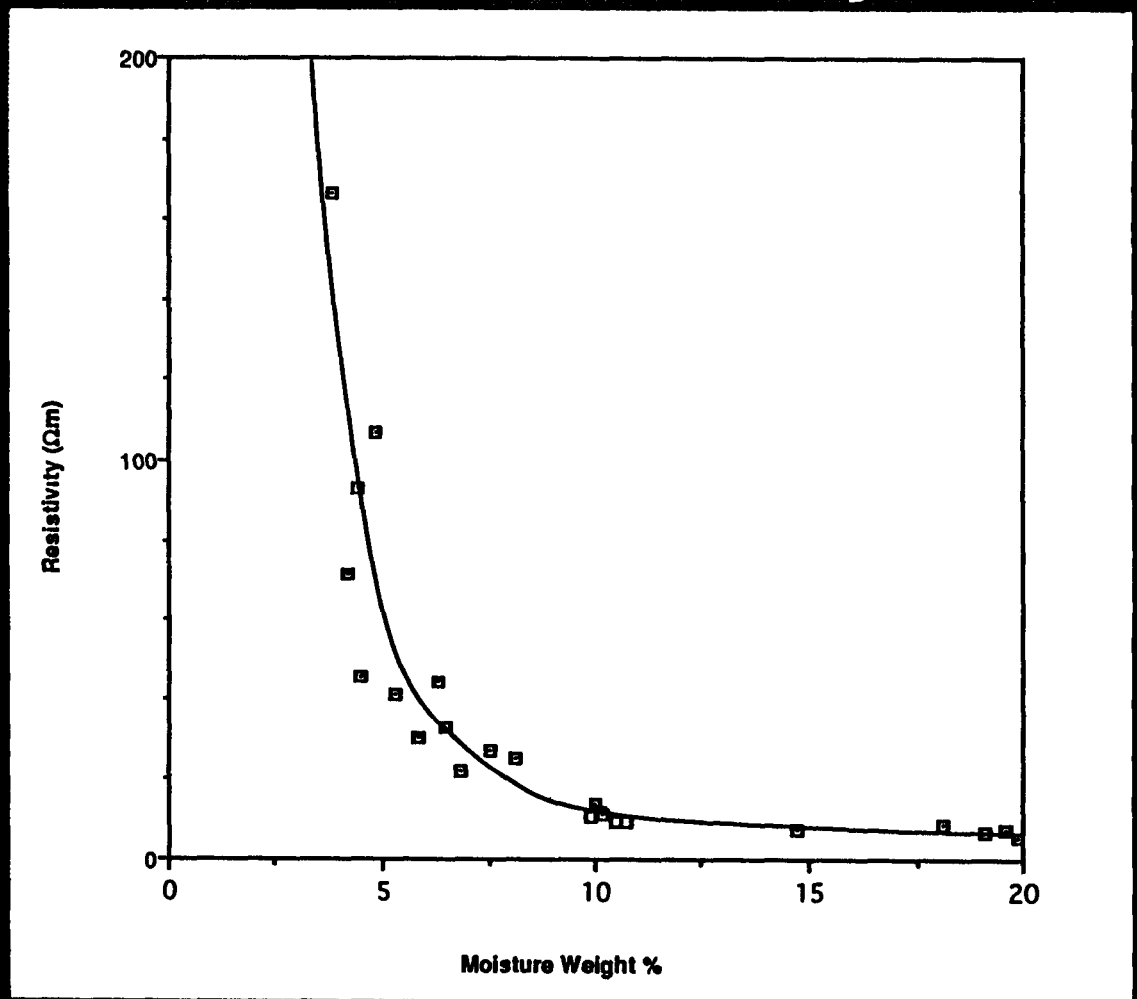
Soil Resistivity



Draft

Subsurface Interim Measures/Interim Remedial Action
Soil Vapor Extraction Pilot Test Plan
Site No 2

Enhanced Vapor Extraction of Organic Compounds with Electrical Subsurface Heating
Operable Unit No 2

East Trenches Area

U S Department of Energy

Rock Flats Plant
Golden Colorado

Environmental Restoration Management

July 1994

1 0 Introduction (only a few paragraphs long)

what is the problem (background of RF objectives of demo)
how do we propose to solve it (brief overview of SPSH)
how do we know if we ve solved it (criteria for success)

(what is the problem)

2 0 Objectives

2 1 Purpose of Demonstration

The purpose of this pilot test is to determine if SPSH is an appropriate technology for removal of VOCs at the Rocky Flats site

2 2 Criteria for success

1 Show acceleration of VOC removal over conventional SVE at the Rocky Flats site

2 Show an increase in the extent of removal over conventional SVE of VOCs existing with inhibiting co-contaminants at the Rocky Flats site

3 Collect sufficient data to project economic feasibility and O&M reliability of additional application of SPSH-SVE at Rocky Flats sites

3 0 Background

3 1 Rocky Flats Site Background

3 1 1 Contamination History (what was the purpose of the Rocky Flats Plant what waste was dumped in this trench when was it dumped)

3 1 2 IHSS 110 Trench and Operable Unit 2

3 1 3 Geological Characterization (general discussion about the site geology soil stratigraphy - very little specific data unless it helps the reader understand the site)

3 1 4 Contamination Characterization (soil gas surveys soil contamination samples extraction well concentrations,etc)

3 2 Remediation of VOC contaminated soil

3 2 1 SVE (brief description of SVE in what situations is it effective)

3 2 2 Thermally Enhanced SVE (why does thermal enhancement work what are the traditional methods and their drawbacks brief mention of SPSH)

3 3 SVE Pilot Test No 1 results (what data was collected during this test how it will be used to compare against pilot test no 2)

(how we propose to solve the problem)

4 0 Approach (SPSH Description and Equipment)

4 1 SPSH Technology Profile (geometry physics how it works)

4 2 Process Description - what we expect to happen in the soil during SPSH (describe the heating patterns how permeabilities will change, additional driving force for flow with steam generation changes in equilibrium of contaminants between liquid and gas phases etc)

4 3 Power System/Electrodes

4 4 Venting (there is a need for improved venting due to low permeability soil)

4 4 1 Vertical/Horizontal Vents (both positive and negative pressure some general discussion about screening depth)

4 4 2 Surface Plenum (most contamination near surface to capture this and increase flowrate a surface vent is important)

4 4 3 Expected Flowrates (brief description of expected flowrates and the models used to get them)

4 5 Heating (what SPSH heating pattern looks like and how it is accomplished)

4 5 1 Water addition (why we need water addition how - generally- we plan to do it)

4 5 2 Energy Control (what mode of operation -constant power or voltage- are we planning to use and why)

(how we know if we solved the problem)

5 0 Technical Data Collection Strategy

5 1 overview

5 1 1 Baseline test

a Purpose (test of SVE for comparison to SPSH)

b Duration (as long as it takes to determine SVE performance use model to predict this duration)

5 1 2 Heating test to compare

a Expected differences (how SPSH will be different from SVE)

b Duration (when do we quit?)

5 1 3 Modeling (overview of TOUGH2 model what it can accurately model what it can t what are it s results)

5 2 Characterization

5 2 1 Data for Modeling (data needed for modeling absolute and relative permeabilities capillary pressure vs water content thermal conductivities, heat capacities etc)

5 2 2 Pre-Test Data for Demonstration Performance Evaluation (data needed to evaluate SPSH performance core samples before the test etc)

5 2 3 On-Line Sampling and Test Monitoring (off gas concentrations power related data temperatures pressures etc)

5 2 4 Post-Test Characterization (data needed to compare to pre-test data for SPSH performance evaluation core samples after the test etc)

6 0 Technical Data Analysis and Interpretation

6 1 Presentation of Data (plots of pertinent data temperature power and off gas concentration with time etc)

6 2 Effects of Temperature (changes of off gas concentration over traditional SVE conc due to increased vapor pressure decreases in electrical resistivity)

6 3 Effect of soil drying (increases in permeability and electrical resistivity)

6 4 Modeling (modeled predictions of all of the above)

7 0 Cost Data

7 1 Operational (What operating costs will be collected during this test power operator time, maintenance etc)

7 2 Capital (What capital costs are involved with putting together a SPSH treatment system including power supply and transformers electrode installation, drip installation offgas treatment system monitoring equipment etc)

7 3 Alternative remediation methods (Typical costs of other remediation technologies when applied to similar situations)

(details can be in any order)

8 0 Demonstration Equipment

- **8 1 Power Source**
- **8 2 SPSH Power Supply**
- **8 3 SPSH Electrodes and Electrode Wetting System**
- **8 4 Soil Vacuum Vent and Condensate Management System**
- **8 5 Controls Monitoring and Instrumentation**
- **8 6 Offgas Treatment System**
- **8 7 Laboratory and Support Facilities**

9 0 Test Operation and Waste Management

- **9 1 Baseline Soil Vapor Extraction Test**
  - **9 1 1 Test Design**
  - **9 1 2 Test Operation and Monitoring**
- **9 2 Six Phase Soil Heating Test**
  - **9 2 1 System Start-Up**
  - **9 2 2 Operation During Demonstration**
    - **9 2 2 1 Electrical System**
    - **9 2 2 2 Gas Sampling and Equipment Monitoring**
    - **9 2 2 3 Condensate Management**
  - **9 2 3 Shut Down Operations**
    - **9 2 3 1 Normal Shut-Down Procedures**
    - **9 2 3 2 Emergency Shut-Down Procedures**
  - **9 2 4 Response to System Anomalies**
    - **9 2 4 1 Loss of SPSH Power Control**
    - **9 2 4 2 Offgas Treatment System Failure**
    - **9 2 4 3 Monitoring Failure**
    - **9 2 4 4 Loss of Power**

10 0 Schedule of Events and Deliverables
- 10 1 Test Plan Development
- 10 2 Field Mobilization
- 10 3 Operations Schedule
- 10 4 Final Report
- 10 5 Records Turnover

11 0 Health & Safety Planning
- 11 1 Demonstration Safety Plan
- 11 2 Notification and Emergency Procedures

12 0 Permits
- 12 1 Operational Permits
- 12 2 Patents

13 0 Sampling Plan/Data Management/DQO s

14 0 References

Appendix

1 Division of Responsibilities (PNL EG&G WC)
2 Detailed Designs